L.Log 2: What is tightly packed DNA called

Cellular Reproduction

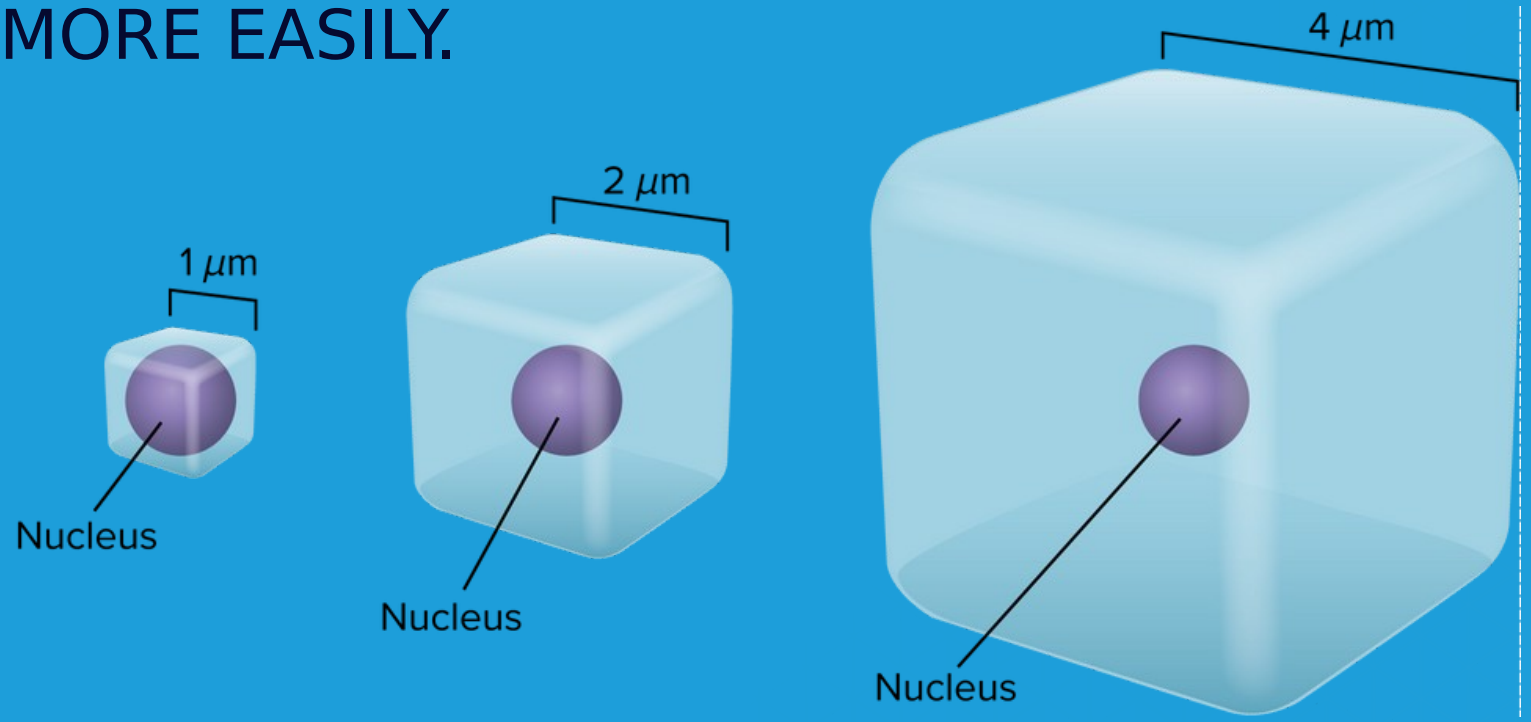
Cell Size Limitations

RATIO OF SURFACE AREA TO VOLUME

- Several factors influence cell size.
- Surface area is the area covered by the plasma membrane.
- The plasma membrane is the structure through which all the nutrients and waste products must pass.
- Volume is the space taken up by the inner contents of the cell.

Cell Size Limitations

- THE RATIO OF SURFACE AREA TO VOLUME DECREASES AS A CELL GETS BIGGER.
- CELLS WITH A HIGHER RATIO OF SURFACE AREA TO VOLUME CAN SUSTAIN THEMSELVES MORE EASILY.



Cell Size Limitations

TRANSPORT OF SUBSTANCES

- Smaller cells can transport substances more easily.
- Diffusion is inefficient over longer distances.
- The cytoskeleton transportation network becomes less efficient for a cell if the distance to travel becomes too large.

CELLULAR COMMUNICATION

- Cellular communication is more efficient in smaller cells.

Chromosomes

CHROMATIN AND CHROMOSOMES

- CHROMATIN IS THE RELAXED FORM OF DNA.
- CHROMOSOMES ARE CONDENSED STRUCTURES THAT CONTAIN THE DNA THAT ARE VISIBLE DURING MITOSIS.
- They are passed from generation to generation.
- Eukaryotic DNA is organized into chromosomes.
- The phosphate groups in DNA create a negative charge, which attracts the DNA to the positively charged histone proteins and form a nucleosome.
- The nucleosomes group together into chromatin fibers, which supercoil to make up the chromosome.

The Cell Cycle

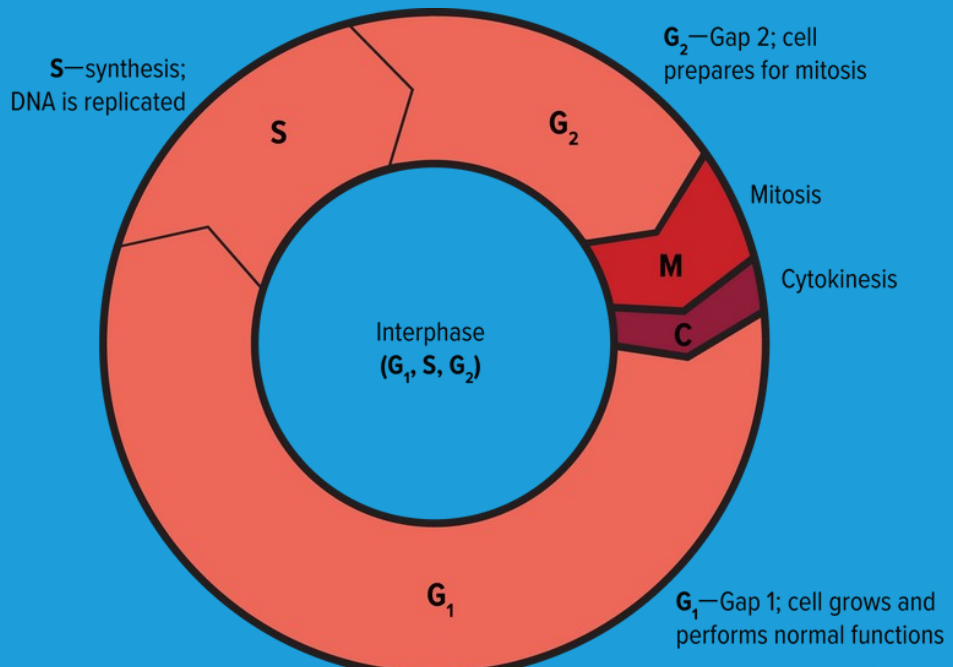
- Cells reproduce by a cycle of growing and dividing called the cell cycle.

INTERPHASE

- INTERPHASE IS THE STAGE DURING WHICH THE CELL GROWS, DEVELOPS INTO A MATURE, FUNCTIONAL CELL, DUPLICATES THE DNA IN ITS NUCLEUS, AND PREPARES FOR DIVISION.
- Interphase is divided into three stages: Gap 1(G_1), synthesis (S), and Gap 2 (G_2).

The Cell Cycle

- GAP 1(G_1): GROWING, CARRYING OUT NORMAL CELLULAR FUNCTIONS, AND PREPARING TO REPLICATE DNA
- SYNTHESIS (S): COPYING DNA TO PREPARE FOR DIVISION
- Gap 2 (G_2): preparing for the division of nucleus



The Cell Cycle

MITOSIS

- The stage of the cell cycle during which the cell's nucleus and nuclear material divide is called mitosis.
- The cell's replicated genetic material separates and the cell prepares to split into two.
- In multicellular organisms, mitosis increases the number of cells in young, growing organisms.
- Organisms also use mitosis to replace damaged cells.
- Mitosis also helps maintain chromosome number

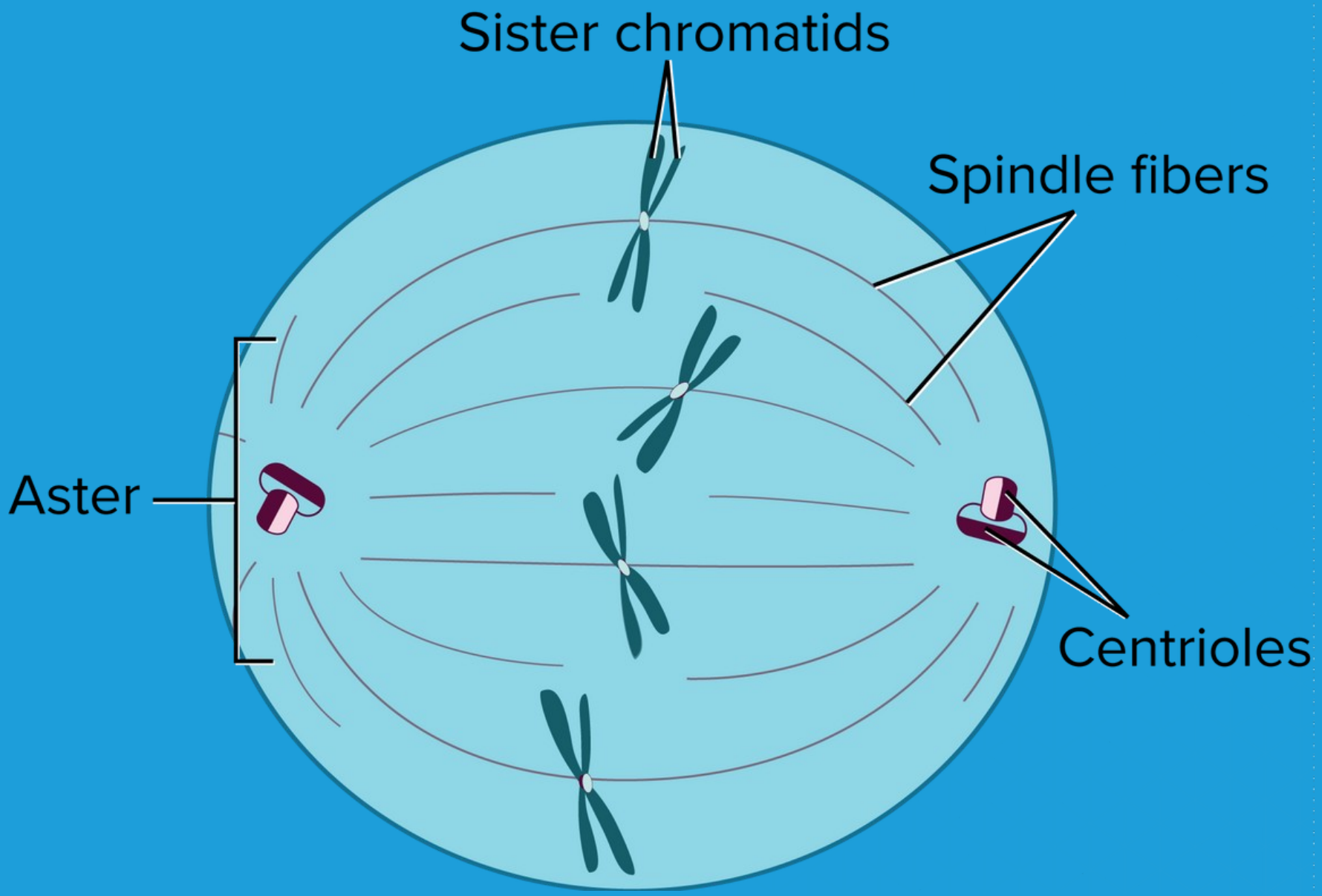
The Cell Cycle

THE STAGES OF MITOSIS

PROPHASE: THE FIRST AND LONGEST STAGE OF MITOSIS

- Chromatin condenses into chromosomes.
- SISTER CHROMATIDS ARE STRUCTURES THAT CONTAIN IDENTICAL COPIES OF DNA. THEY ARE ATTACHED AT THE CENTROMERE.
- As prophase continues, spindle fibers, centrioles, and aster fibers form a spindle apparatus, as shown in the next slide.
- The apparatus attaches to each of the sister chromatids before cell division.

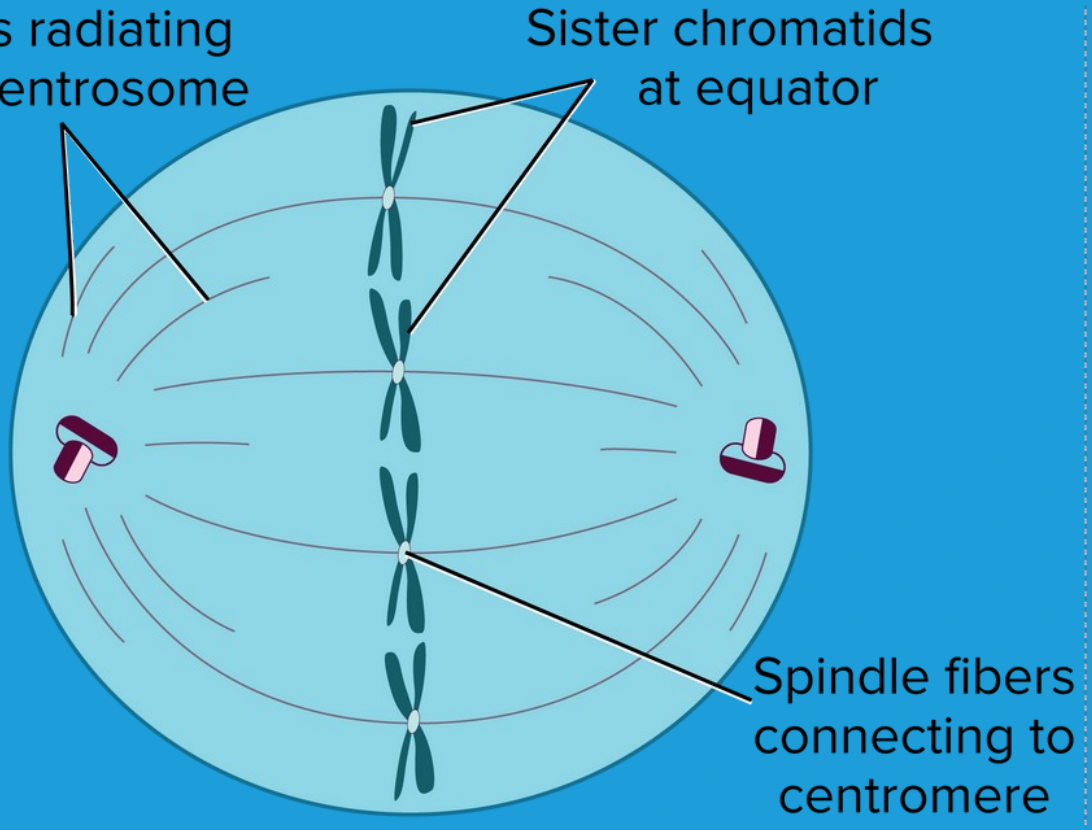
The Cell Cycle



The Cell Cycle

METAPHASE: THE SECOND STAGE OF MITOSIS

- Sister chromatids are pulled along the spindle apparatus toward the center of the cell and line up.



The Cell Cycle

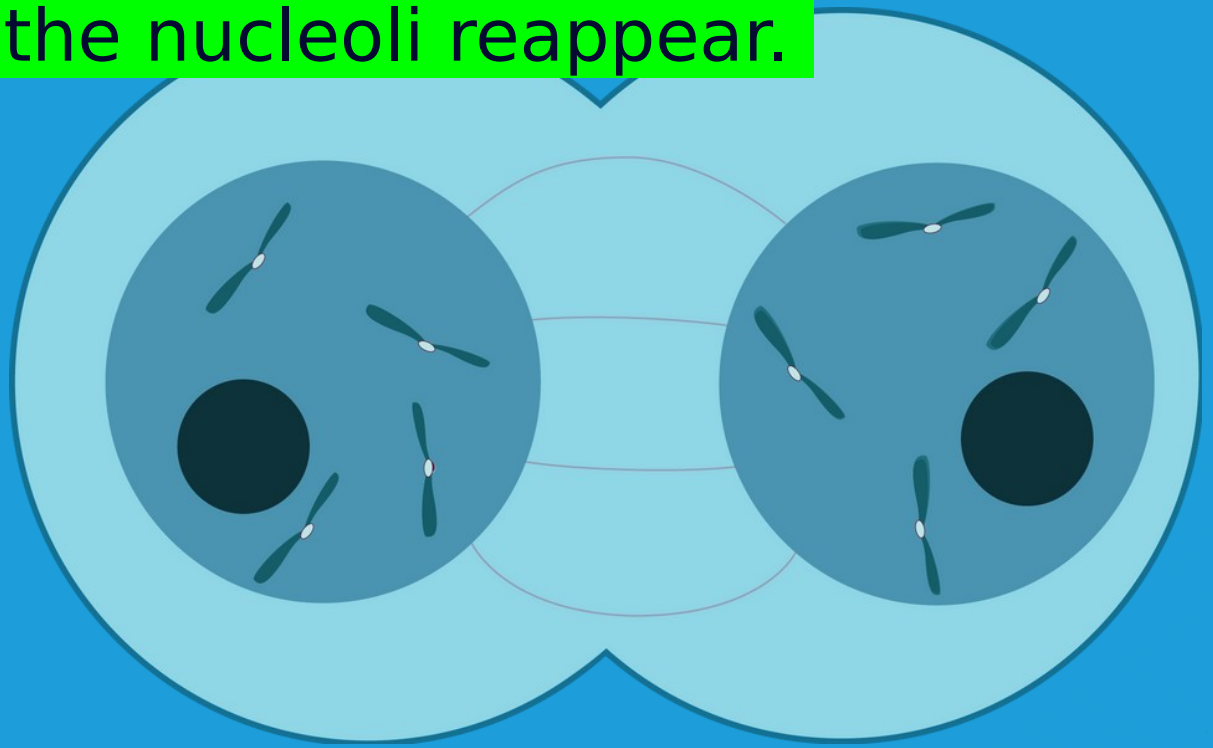
ANAPHASE: THE THIRD STAGE OF MITOSIS

- Chromatids pull apart.
- Microtubules of the spindle apparatus begin to shorten.
- Sister chromatids separate.
- Chromosomes move toward the poles of the cell.

The Cell Cycle

TELOPHASE:

- Chromosomes arrive at poles and begin to relax.
- Two new nuclear membranes begin to form and the nucleoli reappear.



The Cell Cycle

Cytokinesis

- THE END OF MITOSIS, THE CELL BEGINS CYTOKINESIS BY WHICH A CELL'S CYTOPLASM DIVIDES, RESULTING IN TWO CELLS WITH IDENTICAL NUCLEI.
- DURING CYTOKINESIS IN ANIMAL CELLS, MICROFILAMENTS CONSTRICT/PINCH OFF TO FORM TWO CELLS.
- In plant cells, instead of pinching in half, a new structure called the cell plate forms between the two daughter nuclei.

Cell Cycle Regulation

- Cells have specific instructions for carrying out and completing the cell cycle.
- The complex system sometimes fails.

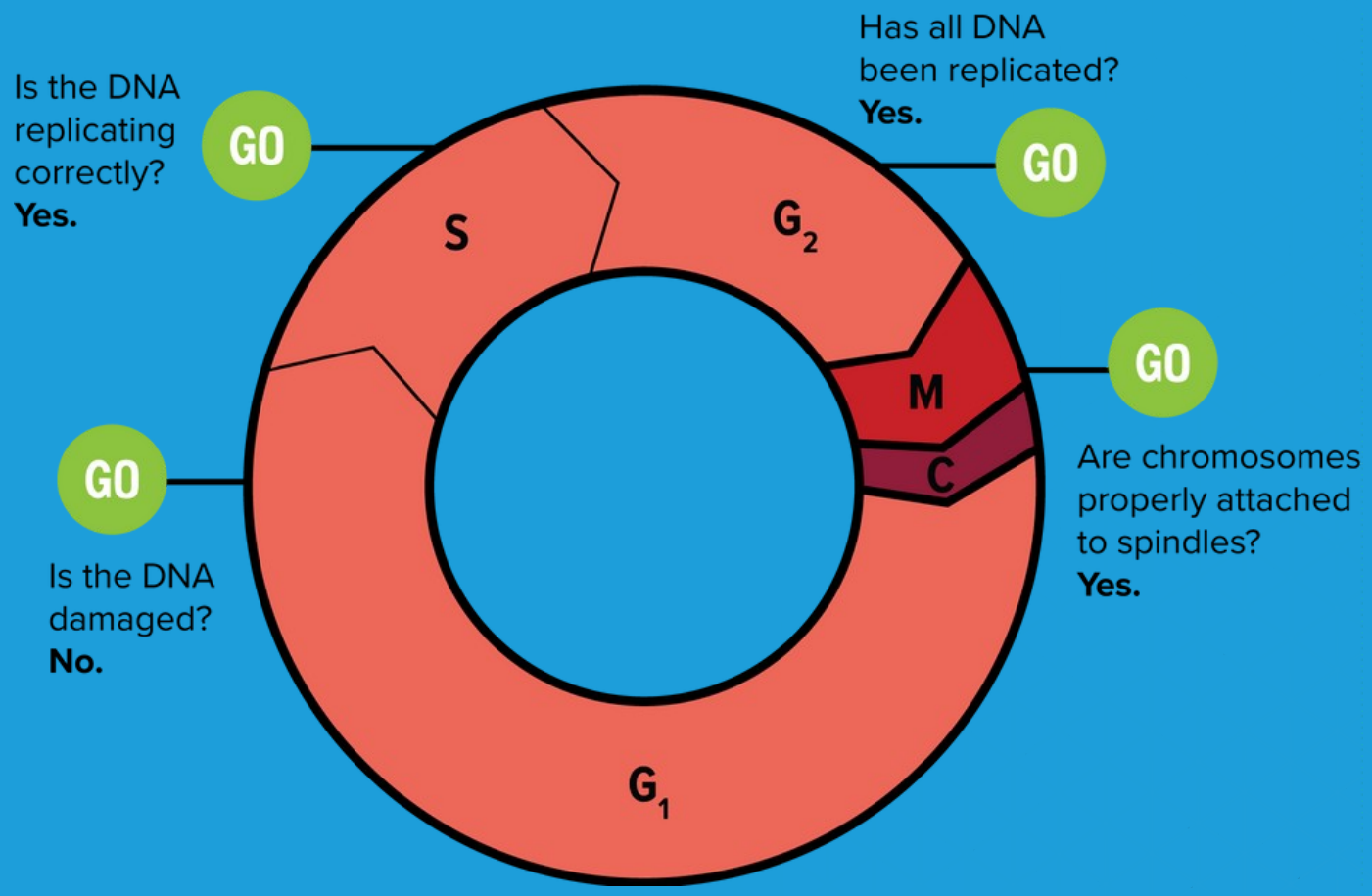
THE ROLE OF CYCLINS

- The cell cycle in eukaryotic cells is driven by a combination of two substances.
- Proteins called cyclins bind to enzymes called cyclin-dependent kinases (CDKs).
- Different cyclin/CDK combinations control different activities during different stages of the cell cycle.

Cell Cycle Regulation

QUALITY CONTROL CHECKPOINTS

- Built-in checkpoints monitor the cycle and can stop it if something goes wrong.



Cell Cycle Regulation

APOPTOSIS

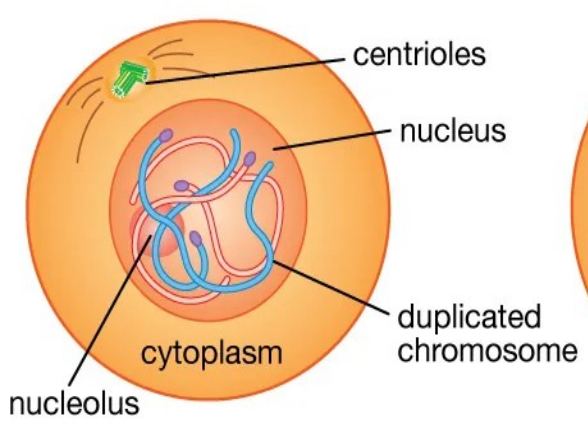
- Not every cell is destined to survive. Some cells go through apoptosis, or programmed cell death.
- These cells shrink or shrivel in a controlled process.
- An example of apoptosis occurs in the development of the human hand and foot. Cells in spaces between fingers and toes undergo apoptosis.
- An example in plants is the localized death of cells that results in leaves falling from trees during autumn.

Cell Cycle Regulation

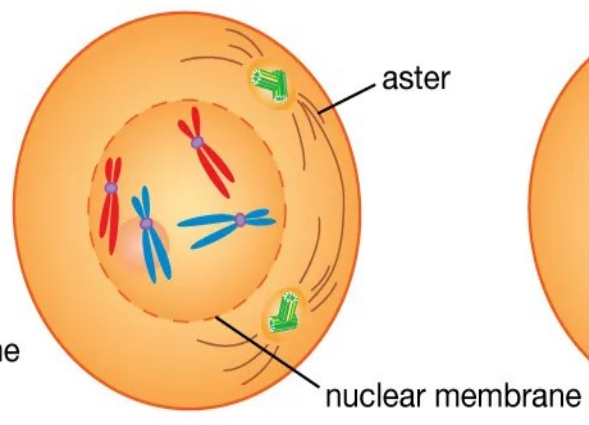
ABNORMAL CELL CYCLE: CANCER

- CANCER IS THE UNCONTROLLED GROWTH AND DIVISION OF CELLS. CANCER RESULTS WHEN CELLS STOP RESPONDING TO THE CONTROLS OF THE CELL CYCLE.
- Cancer cells can kill an organism by crowding out normal cells, resulting in loss of tissue function.

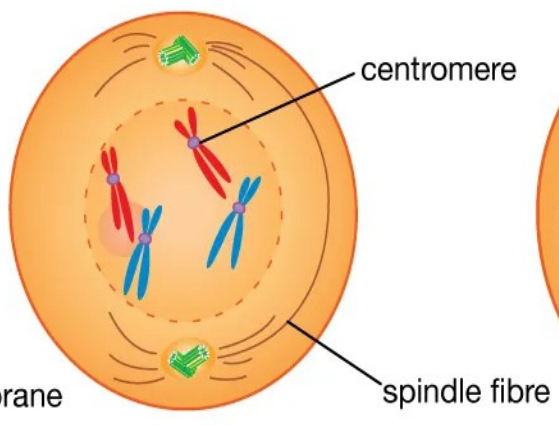
Mitosis, or somatic cell division



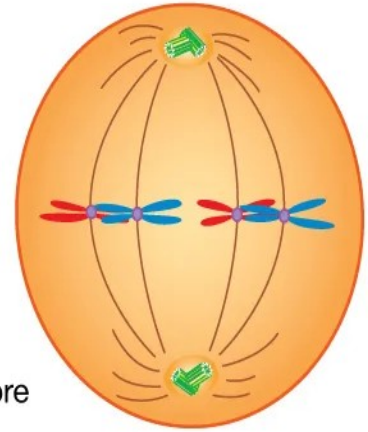
Prior to mitosis, each chromosome makes an exact duplicate of itself. The chromosomes then thicken and coil.



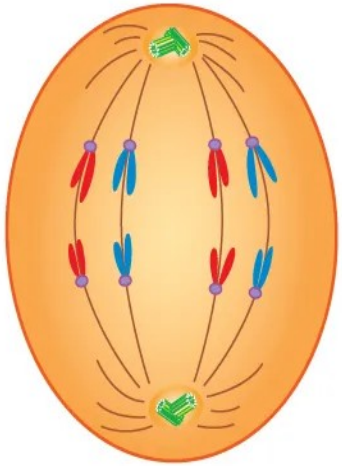
In early prophase the centrioles, which have divided, form asters and move apart. The nuclear membrane begins to disintegrate.



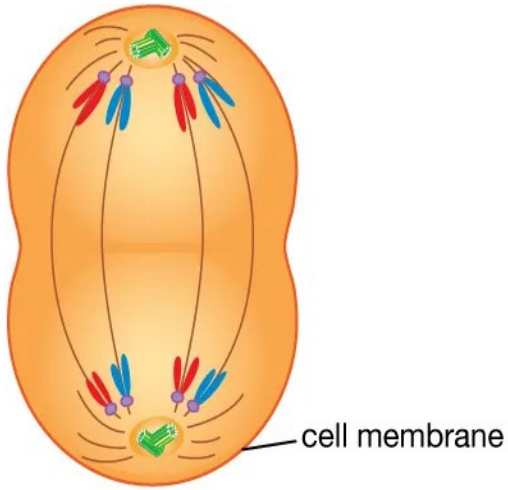
In late prophase the centrioles and asters are at opposite poles. The nucleolus and nuclear membrane have almost completely disappeared.



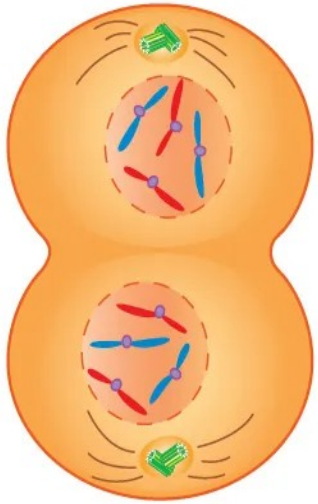
The doubled chromosomes—their centromeres attached to the spindle fibres—line up at mid-cell in metaphase.



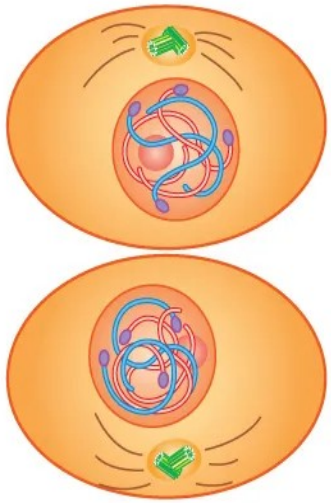
In early anaphase the centromeres split. Half the chromosomes move to one pole, half to the other pole.



In late anaphase the chromosomes have almost reached their respective poles. The cell membrane begins to pinch at the centre.



The cell membrane completes constriction in telophase. Nuclear membranes form around the separated chromosomes.



At mitosis completion, there are two cells with the same structures and number of chromosomes as the parent cell.

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Cell Cycle Regulation

CAUSES OF CANCER

- Mutations cause cancer cell growth and division.
- Environmental factors can affect the occurrence of cancer cells.
- CARCINOGENS ARE SUBSTANCES OR AGENTS KNOWN TO CAUSE CANCER.
- Not all cancers can be prevented, but avoiding known carcinogens can help reduce the risk.

CANCER GENETICS

- More than one change in DNA is required to change an abnormal cell into a cancer cell.
- This might explain why risk increases with age.

Closure: How many chromosomes does a human have

L.log 2: is Mitosis A sexual or sexual

Meiosis and Sexual Reproduction

Chromosome Numbers

HAPLOID AND DIPLOID CELLS

- GAMETES ARE SEX CELLS THAT HAVE HALF THE NUMBER OF CHROMOSOMES. THE SYMBOL N IS USED TO REPRESENT THE NUMBER OF CHROMOSOME. IN HUMANS, N IS 23.
- A cell with n number of chromosomes is called haploid.
- FERTILIZATION IS THE PROCESS BY WHICH ONE HAPLOID GAMETE COMBINES WITH ANOTHER HAPLOID GAMETE.
- A cell that contains 2n number of chromosomes is called a diploid cell.

Chromosome Numbers

Sex Determination

- EACH CELL IN YOUR BODY, EXCEPT FOR GAMETES, CONTAIN 23 PAIRS OF CHROMOSOMES.
- ONE OF THESE PAIRS, THE SEX CHROMOSOMES, DETERMINE AN INDIVIDUAL'S Sex.
- THE OTHER 22 PAIRS OF CHROMOSOMES ARE CALLED AUTOSOMES.

- There are two types of sex chromosomes—X and Y. Individuals with two X chromosomes are female. Individuals with X and Y are male.

Meiosis I

- GAMETES FORM DURING MEIOSIS, A TYPE OF CELL DIVISION THAT REDUCES THE NUMBER OF CHROMOSOMES.
- MEIOSIS OCCURS IN THE REPRODUCTIVE STRUCTURES OF ORGANISMS THAT REPRODUCE SEXUALLY, FORMING HAPLOID GAMETES OR SPORES.
- IT REDUCES THE CHROMOSOME NUMBER BY HALF THROUGH THE SEPARATION OF HOMOLOGOUS CHROMOSOMES.

Meiosis I

INTERPHASE

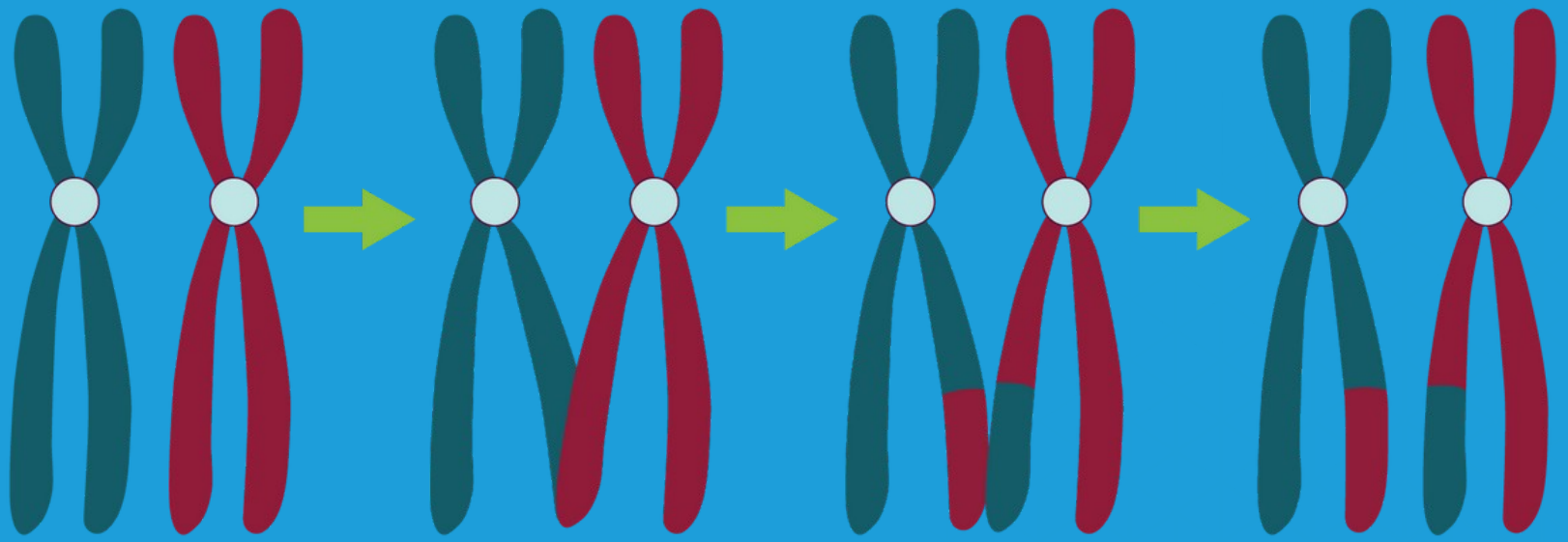
- Chromosomes replicate.
- Chromatin condenses.

PROPHASE I

- Homologous chromosomes pair. Each chromosome consists of two chromatids.
- Crossing over produces the exchange of genetic information. The next slide illustrates the process.
- The nuclear envelope breaks down.
- Spindles form.

Meiosis I

Crossing over is a process during which chromosomal segments are exchanged between a pair of homologous chromosomes.



Meiosis I

METAPHASE I

- Chromosome centromeres attach to spindles.
- Homologous chromosomes line up at equator.

ANAPHASE I

- Homologous chromosomes separate and move to opposite poles of the cell.

TELOPHASE I

- Spindles break down.
- Chromosomes uncoil to form two nuclei.
- The cell divides.

Meiosis II

PROPHASE II

- Chromosomes condense.
- Spindles form in each new cell.
- Spindle fibers attach to chromosomes.

METAPHASE II

- Centromeres of chromosomes line up randomly at the equator of each cell.

ANAPHASE II

- Centromeres split.
- Sister chromatids separate and move to opposite poles.

Meiosis II

TELOPHASE II

- Four nuclei form around chromosomes.
- Spindles break down.
- Cells divide.

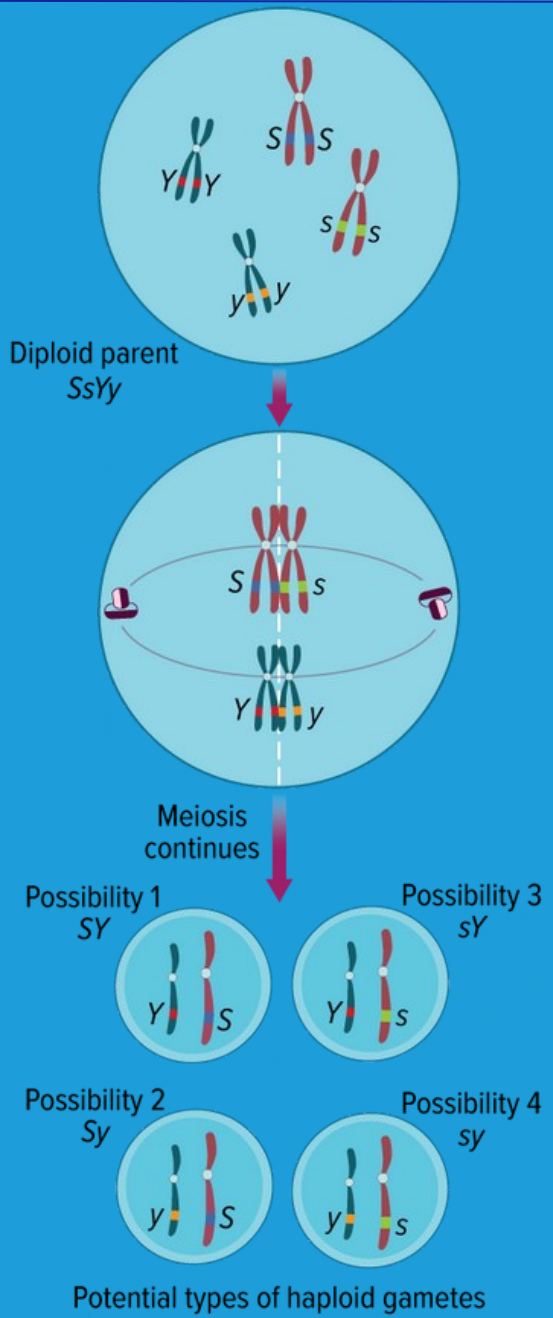
PRODUCTS

- Four cells have formed.
- Each nucleus contains a haploid number of chromosomes.

The Importance of Meiosis

MEIOSIS PROVIDES VARIATION

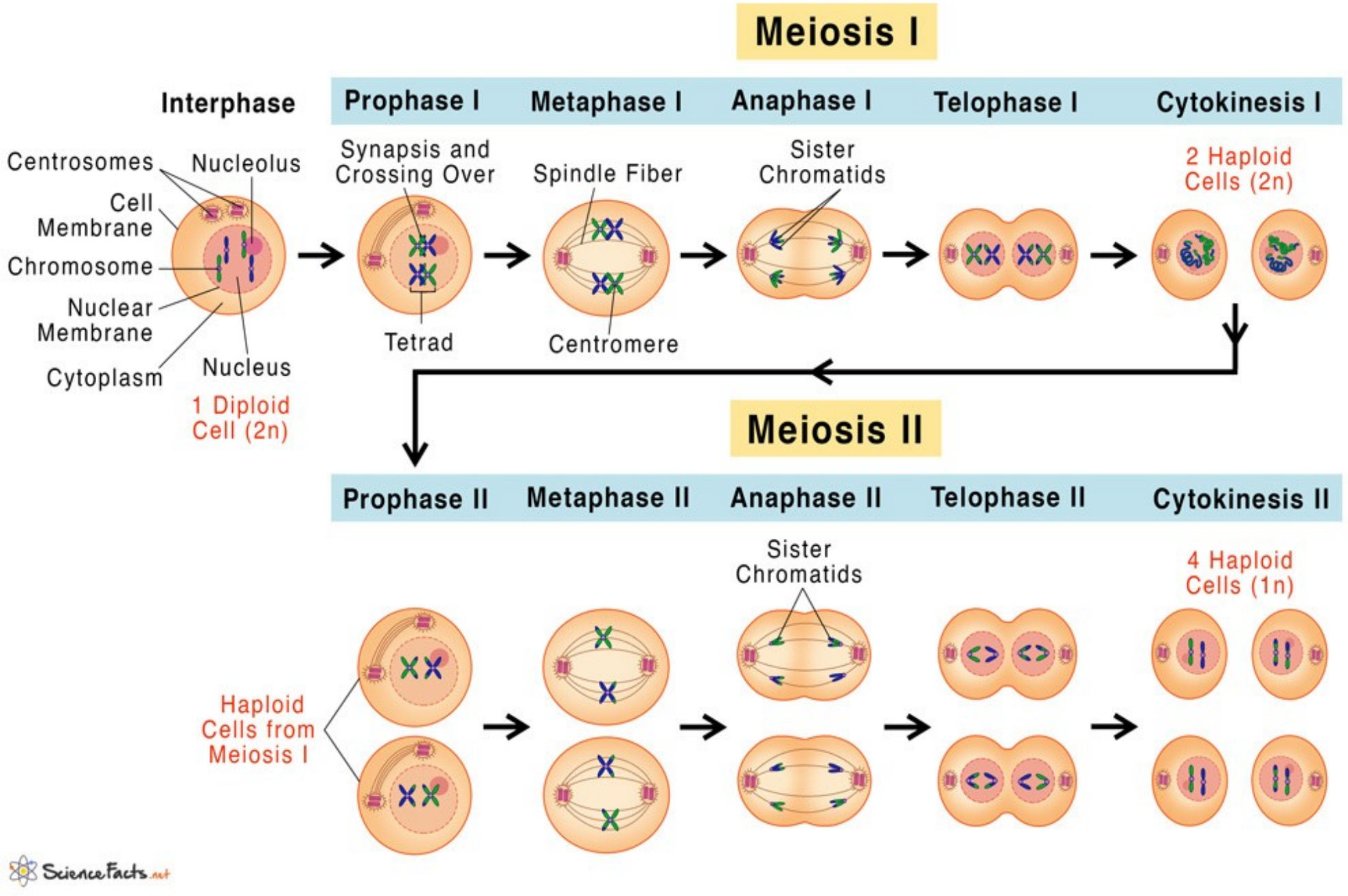
- Depending on how chromosomes line up at the equator, four gametes with four different combinations of chromosomes can result.
- This independent assortment of alleles during gamete formation is a source of genetic variation.



Telomeres

- TELOMERES ARE CHROMOSOMES THAT END IN PROTECTIVE CAPS THAT CONSIST OF DNA ASSOCIATED WITH PROTEINS.
- The cap serves a protective function for the structure of the chromosome.
- Telomeres might be involved in aging and cancer.

Meiosis



ScienceFacts.net

Sexual Reproduction v. Asexual Reproduction

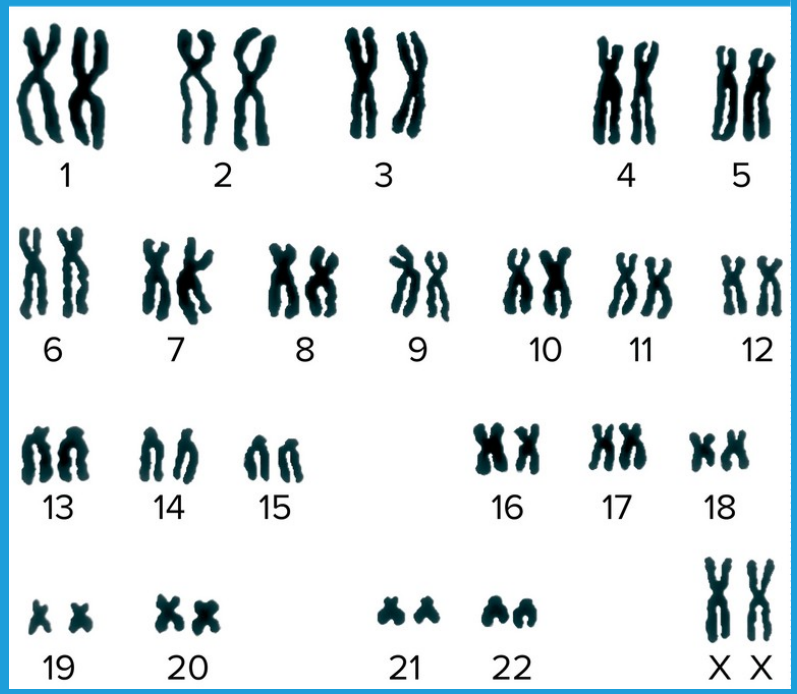
- DURING ASEXUAL REPRODUCTION, CHROMOSOME NUMBER IS MAINTAINED BY MITOSIS.
- THE ORGANISM INHERITS ALL OF ITS CHROMOSOMES FROM A SINGLE PARENT.
- THE NEW INDIVIDUAL IS GENETICALLY IDENTICAL TO ITS PARENT.
- BACTERIA REPRODUCE ASEXUALLY, WHEREAS MOST PROTISTS REPRODUCE BOTH ASEXUALLY AND SEXUALLY, DEPENDING ON ENVIRONMENTAL CONDITIONS.
- MOST PLANTS AND MANY OF THE MORE SIMPLE ANIMALS CAN REPRODUCE BOTH ASEXUALLY AND SEXUALLY.

Karyotypes and Nondisjunction

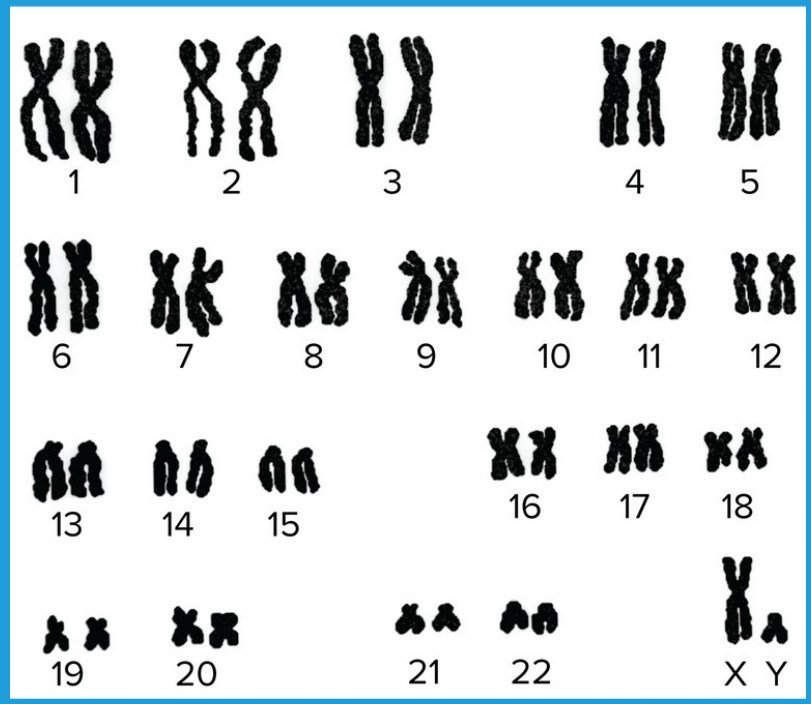
KARYOTYPES

- A karyotype is a type of micrograph in which the pairs of homologous chromosomes are arranged in decreasing size.

Female karyotype



Male karyotype



Karyotypes and Nondisjunction

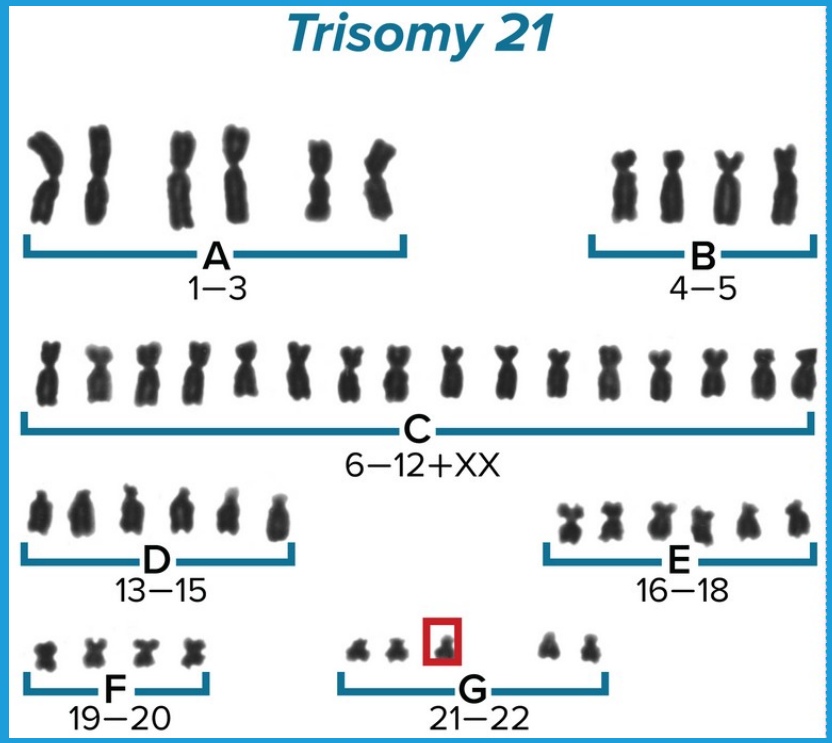
NONDISJUNCTION

- Cell division during which sister chromatids fail to separate properly (which happens occasionally) is called nondisjunction.
- Nondisjunction can result in extra copies of certain chromosomes or only one copy of a particular chromosome in offspring.
- In humans, alterations of chromosome numbers are associated with serious disorders, which are often fatal.

Karyotypes and Nondisjunction

AUTOSOMES

- Autosomes are chromosomes that are not sex chromosomes.
- Humans typically have 22 pairs of autosomes.
- Down syndrome is the result of an extra chromosome 21 and



Karyotypes and Nondisjunction

SEX CHROMOSOMES

- Nondisjunction occurs in both autosomes and sex chromosomes.
- An individual with Turner's syndrome has only one sex chromosome. The condition results from fertilization with a gamete that had no sex chromosome.
- An individual with Klinefelter syndrome has three sex chromosomes. This condition results from fertilization with a gamete that had two sex chromosomes.

Closure: What is the final phase of mitosis

L.log 2: What is nondisjunction?

Clear desks and one person get a chromebook.

Closure: What is an autosome?